

## Description of Larval and Pupal Stages of *Tipula* (*Nippotipula*) *sinica* (Diptera, Tipulidae) from South Korea with Ecological Notes

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### ABSTRACT

The external anatomy of the immature stages (last instar larva and pupa) of the crane fly, *Tipula* (*Nippotipula*) *sinica* Alexander, 1935 (Diptera: Tipulidae) is described and illustrated from specimens first collected in Korean peninsula (South Korea). Comments concerning natural history and microhabitats of larvae are provided. This is the first detailed description with illustrations for the last instar larva and pupa of *Tipula* (*Nippotipula*) *sinica*. Pupal characteristics resemble those of most species from advanced lineages within the subfamily Tipulinae. And, also it described with habitats and biological notes of *Tipula* (*Nippotipula*) *sinica*. Crane fly larvae, categorization as found in this survey indicate a taxonomic stream and are expected to help.

**Keywords:** crane fly, Diptera, immature stages, last instar, Korean peninsula

### INTRODUCTION

The subgenus *Nippotipula* of tipulid flies has been recorded in 20 species around the world (Oosterbroek, 2015). Of these, four species have been recorded from the palearctic region. In Korea and Japan, only two species, *Tipula* (*Nippotipula*) *coquilletti* Enderlein, 1912 and *Tipula* (*Nippotipula*) *sinica* Alexander, 1935 have been recorded (Torii, 2012; Jo and Kong, 2012, 2014; Jo, 2013). Morphological characteristics of this adult species were reported in previous research (Jo, 2013; Jo and Kong, 2014). This study is the first with a description with illustrations of the *Tipula* (*Nippotipula*) *sinica* larva and pupa and comments concerning the natural history and microhabitats of larvae are provided.

The larvae and pupae were collected in Mt. Gwanggyo-san, Sanggwanggyo-dong, Suwon-si, Jangan-gu, Gyeonggi-do, South Korea (GPS: 37°20'25.7"N, 127°1'28.28"E) (Fig. 1). Surber nets and hand nets were used for larvae sampling in bottom substrates from a mountain stream. We reared these specimens in the laboratory. Specimens were studied with an OLYMPUS dissecting microscope (Olympus, Tokyo,

Japan) and NIKON D7000 digital camera (Nikon, Tokyo, Japan). The larvae used in this study were killed by dropping them into near boiling hot water. After 5 min, specimens were transferred to 10% formalin and left for several weeks. Then, they were preserved in 70% ethanol for permanent storage (Kim and Lee, 2005). Head capsules were prepared and studied by immersing for 30 mins in hot water with 10% KOH and preserved in glycerin. The terminology of morphological features generally follows that of Chiswell (1955) and Gelhaus (1986, 2002).

### SYSTEMATIC ACCOUNTS

Order Diptera Linnaeus, 1758  
Family Tipulidae Latreille, 1802  
Subfamily Tipulinae Latreille, 1802  
Genus *Tipula* Linnaeus, 1758  
Subgenus *Nippotipula* Matsumura, 1916  
*Tipula* (*Nippotipula*) Matsumura, 1916

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**Fig. 1.** Habitat of *Tipula* (*Nippotipula*) *sinica* in Mt. Gwanggyosan, Suwon-si, South Korea. A, Adults from the collection site; B, Larvae collection stream.

<sup>1\*</sup>*Tipula* (*Nippotipula*) *sinica* Alexander, 1935 (Figs. 2, 3)

**Specimens examined.** Korea: 2♂, Gangwon-do: Hwacheong-gun, Hwacheon-eup, Dongcheon-ri (near dam), 1 Jun 2012, Jang YC, Oh MW, Park SI; 1♂2♀, Pyeongchang-gun, Jinbunmyeon, Ganpyeong-ri (near stream), 2 Jun 2012, Choi W, Jo JI; 2♂4♀, Gyeonggi-do: Suwon-si, Jangan-gu, Sanggwanggyo-dong, Mt. Gwanggyosan (near stream), 3 Jun 2011, Oh MW, Jo JI; 1♂1♀, Suwon-si, Jangan-gu, Hanggwanggyo-dong (near stream), 2 May 2011, Mang JS, Jo JI; 2♂, Suwon-si, Jangan-gu, Hanggwanggyo-dong, 12 Apr 2011, Ma KN, Jo JI; 1♀, Jeollanam-do: Gurye-gun, Sandong-myeon, Daepyong-ri, 30 Sep 2012, Cho HJ, Han MH, Han SW.

**Larval description.** Last instar larva. Length 45–70 mm; width 5–8 mm. Body color yellowish brown. Head (Fig. 2A–D): length 1.5–3 mm; width 0.5–2 mm. Head capsule black, lateral plates yellowish brown. Mentum of head capsule with seven dark brown teeth. Mandible with two brownish teeth. Thorax. All segments covered with short, brownish, microscopic hairs tight to the body. Abdomen (Fig. 2E, F): each abdominal segment had a transverse ventral swelling and two transverse dorsal swellings, ventral swelling 3 × height. Setae 12 in dorsal part dorsal setae IV long, dorsal setae VI 3-way branched, but difficult to see. Many macroscopic hairs between dorsal setae V and VI: ventral setae I, II and IV subequal ventral setae III long. Spiracular disc (Fig. 2G):

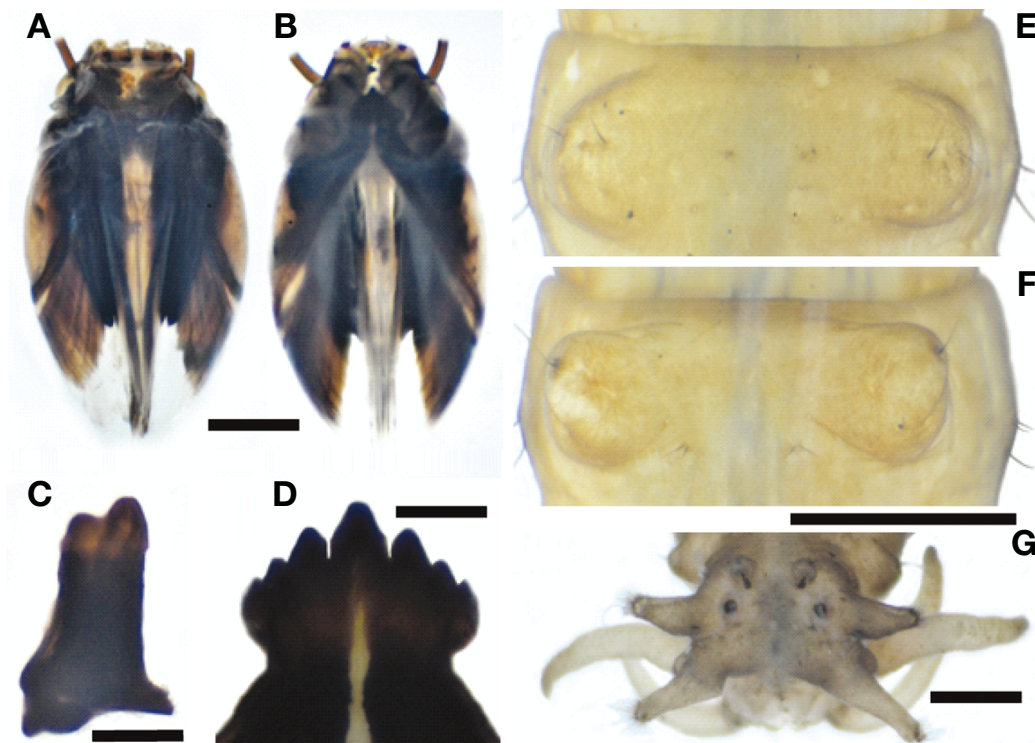
eight lobes; ventral lobes longer; central lobes 1.5 × larger than dorsal lobes. Branched accessory lobes between the lateral lobes and ventral lobes; Posterior surface of each dorsal lobe with a thick, black, shortened sclerite. Small spiracles, distance between spiracles 6 × diameter of spiracle. Anal segment (Fig. 2G): gills six, mid-sized and tangled. Anal field separated from other abdominal part by a thin, black cuticular band.

**Pupal description.** Male pupae length 35–50 mm, width 3–5 mm. Female pupae length 35–55 mm, width 3–6 mm. Body color yellowish brown. Head (Fig. 3A, B): antennae short, moderately elongated; maxillary palpi short with recurved apex and reaching the prothoracic femur. Thorax. Respiratory horn 2.0–2.5 mm in length and slightly curved along entire length. Apex slightly rounded. Wing sheaths reaching slightly over end. Sheaths of fore and hind tarsi in transverse alignment. Abdomen (Fig. 3C, D): segments II–VII with well-defined anterior and posterior annuli. Each side of segments II–VI five large terminal pairs divided into two parts with large spines. Each of segments II–VI ventral side has 4 central small spines in a line. Male genital sheaths with three curved dorsals and a lateral spine near the bend. Females have long lateral dorsal spines and two pairs of large and separate genital sheaths.

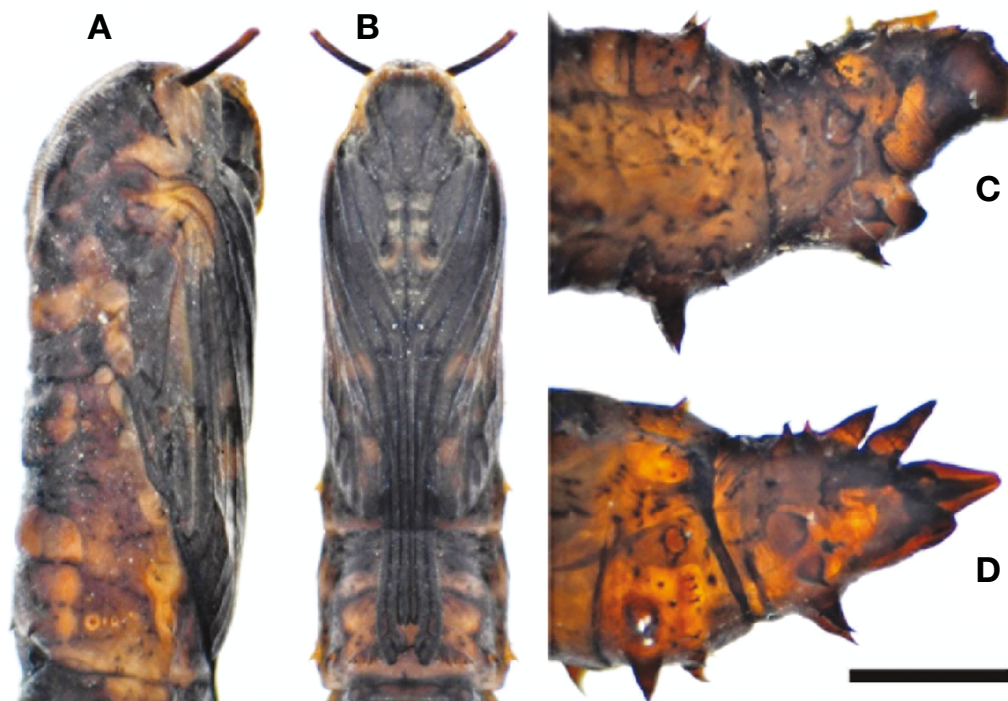
**Distribution.** China, South Korea and Japan.

**Remarks.** All Korean specimens were collected near streams

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**Fig. 2.** Fourth instar larva of *Tipula* (*Nippotipula*) *sinica*. A, Head, dorsal view; B, Head, ventral view; C, Mandible, mesal view; D, Hypostomal bridge, ventral view; E, Abdominal segment VI, dorsal view; F, Abdominal segment VI, ventral view; G, Spiracular area. Scale bars: A, B=0.5 mm, C=0.1 mm, D=0.05 mm, E, F=3 mm, G=5 mm.



**Fig. 3.** Pupa of *Tipula* (*Nippotipula*) *sinica*. A, Lateral aspect; B, Ventral aspect; C, Male; D, Female. Scale bar=3 mm.



and rivers.

**Habitats and biological notes.** The habitat of *Tipula (Nippotipula) sinica* varies from upstream to downstream. Their last instar larvae are mainly found in roots near water plants or rock crevasses. Sometimes, they can be found inside wet trees near river shores. First instar larvae are located in the sand near river shores. They ingest algae and organic material found at river bottoms or river shores. They eat fiber matter like leaves or bark of dead trees they grow. The previous record of the Subgenus *Nippotipula* in South Korea was only *T. coquillettii*. In Gangwon-do (Hwacheon-si), Gyeonggi-do (Suwon-si), Jeollanam-do (Gurye-gun), a new record was confirmed by this study.

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